284

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Title **MAPS OF 3 DAY RAINFALL TOTALS TO ASSESS THE VIABILITY OF UREA AS A NITROGEN FERTILISER FOR SPRING SILAGE.**

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Abstract

A series of trials were carried out by ADAS Soil Science Departments over several years to investigate the relative efficiencies of urea and ammonium nitrate as nitrogen fertilisers for spring silage grass. The results of these are analysed here with respect to the amount of rain falling on the day of application plus the two succeeding days. When this totalled 5 mm or more there was found to be no loss in yield from urea compared to that from similar applications of ammonium nitrate. An analysis was made of the probability of 3 day spells in March, May and June with a total of at least 5 mm of rainfall for 37 climate stations in England and Wales for the period 1961-80. Good regressions were obtained between the probabilities of these 3 day spells and annual average rainfall. Maps were drawn for March, May and June of the percentage probability of receiving 5 mm or more of rainfall in 3 days.

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Introduction

A national series of trials, carried out by ADAS Soil Science Departments during 1983-1985, investigated the efficiency of urea as a nitrogen fertiliser for silage grass. At each site varying rates of nitrogen as urea were compared against similar rates as ammonium nitrate. There were 40 sites in England and Wales.

It is commonly assumed that the efficiency of urea as a fertiliser increases with the amount of rain following application.

In soil urea is converted firstly to ammonium-nitrogen and then to nitrate-nitrogen. In some situations ammonium-nitrogen is converted to ammonia gas which is lost into the atmosphere. This loss is minimised if urea is washed into the soil by rainfall. Urea efficiency was investigated using the results from 1st cut silage yields. At most sites the fertilisers for first cut were applied in March. Figure 1 shows the 'relative yield of urea' plotted against the total rainfall on the day of fertiliser application and the following two days. The term relative yield of urea was calculated from

$$\frac{\text{(Mean yield from plots receiving 80, 120 and 160 kg/ha N as urea)}}{\text{(Mean yield from plots receiving 80, 120 and 160 kg/ha N as ammonium nitrate)}} \times 100\%$$

Although there was a large scatter of relative yield values at each level of total rainfall, it appeared that, when the 3 day rainfall exceeded 5 mm, there was no loss in yield from urea as opposed to ammonium nitrate applications.

With this in mind, it was decided to see if it was possible to predict the likelihood of 5 mm of rainfall within a 3 day spell occurring in March (for first cut silage) and in May and June (for second cut silage) at various locations in England and Wales. For the purpose of this analysis it has been assumed that the response of relative yield to rainfall for 2nd cut silage is similar to that for 1st cut (fig 1).

Results

The occurrence of 3 day spells in March, May and June with a total of at least 5 mm of rain was analysed for 37 climate stations in England and Wales for the period 1961-80. Spells which overlapped each other were counted as separate spells. The frequency of such spells was calculated for each station, and was expressed as a percentage of all 3 day spells in this month. A regression was then obtained between the percentage frequency for each month and the annual average rainfall for the station (a parameter for which maps are readily available). The regressions for the percentage frequency of 3 day spells per year (S) against annual average rainfall (R) are (based on 37 data points each):-

for March $S = 0.024R + 18.3$ $(r = 0.95)$ (i)

for May $S = 0.021R + 21.7$ $(r = 0.97)$ (ii)

for June $S = 0.018R + 19.3$ $(r = 0.86$ (iii)

Regressions (i), (ii) and (iii) were used to produce figs 2(a), (b) and (c) showing the percentage frequency of 3 day spells in March, May and June with at least 5 mm of rain. It can be seen that, for the months of March and May, most of Devon and Cornwall, Wales (except Clwyd), the Pennines and the Lake District are associated with a frequency of $\geqslant 45\%$; this means that on any day in these months the probability of the rainfall on that day and the two following totally $\geqslant 5$ is $\geqslant 0.45$. In to England the probability is $\leqslant 0.35$.

In June (fig 3c) these values fall to around 0.4 and 0.3 respectively.

Conclusions

These results show that it is possible to advise farmers on whether to use urea or ammonium nitrate as a fertiliser for 1st and 2nd cut silage. Of course this assumes that application time is random, whereas in practice farmers could use weather forecasts and endeavour to apply just before a wet period.

Economic Benefits

Recently urea has been cheaper per unit of nitrogen than ammonium nitrate, but the likely economic benefits to the farmer of using urea are rather difficult to predict since fertiliser prices tend to fluctuate from year to year.

Any comments on this paper should be addressed to the author.

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FIG. 1

1st CUT — Urea rel yield v. Rainfall

Rain on day of application + 2 days

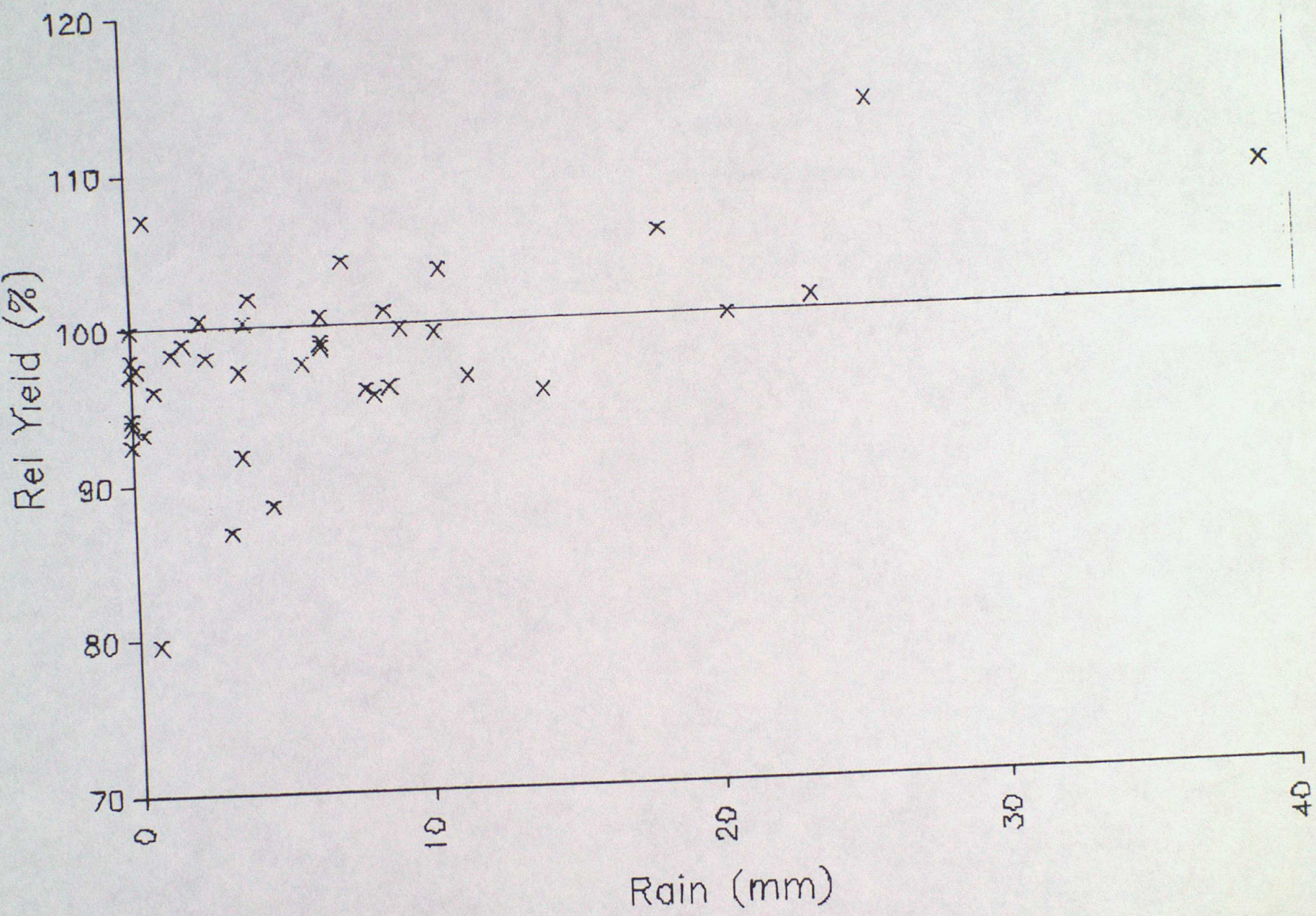

FIG. 2(a)
MARCH

PERCENTAGE PROBABILITY OF RECEIVING ≥5mm RAIN IN 3 DAYS.

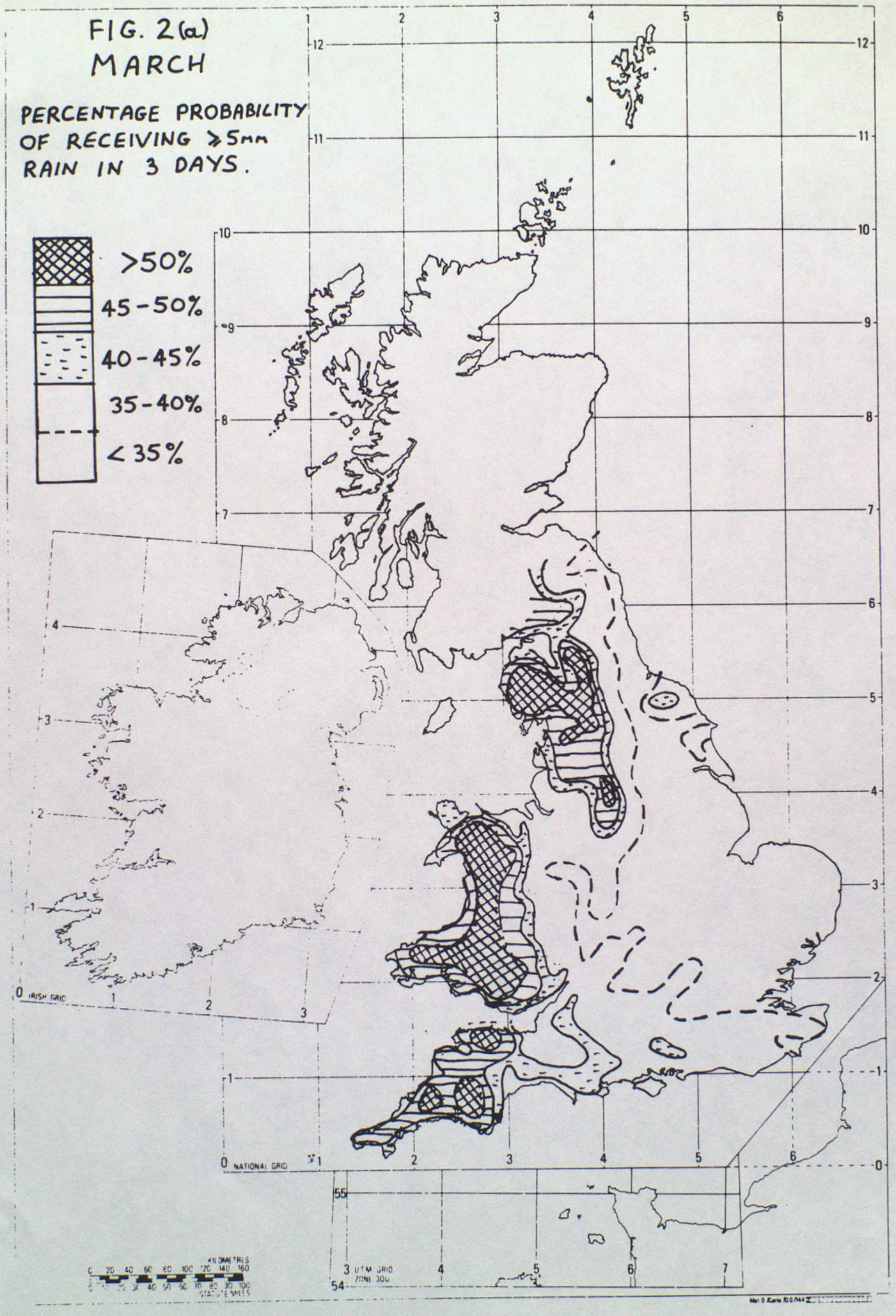

FIG. 2 (b)

MAY

PERCENTAGE PROBABILITY OF RECEIVING ≥ 5mm RAINFALL IN 3 DAYS

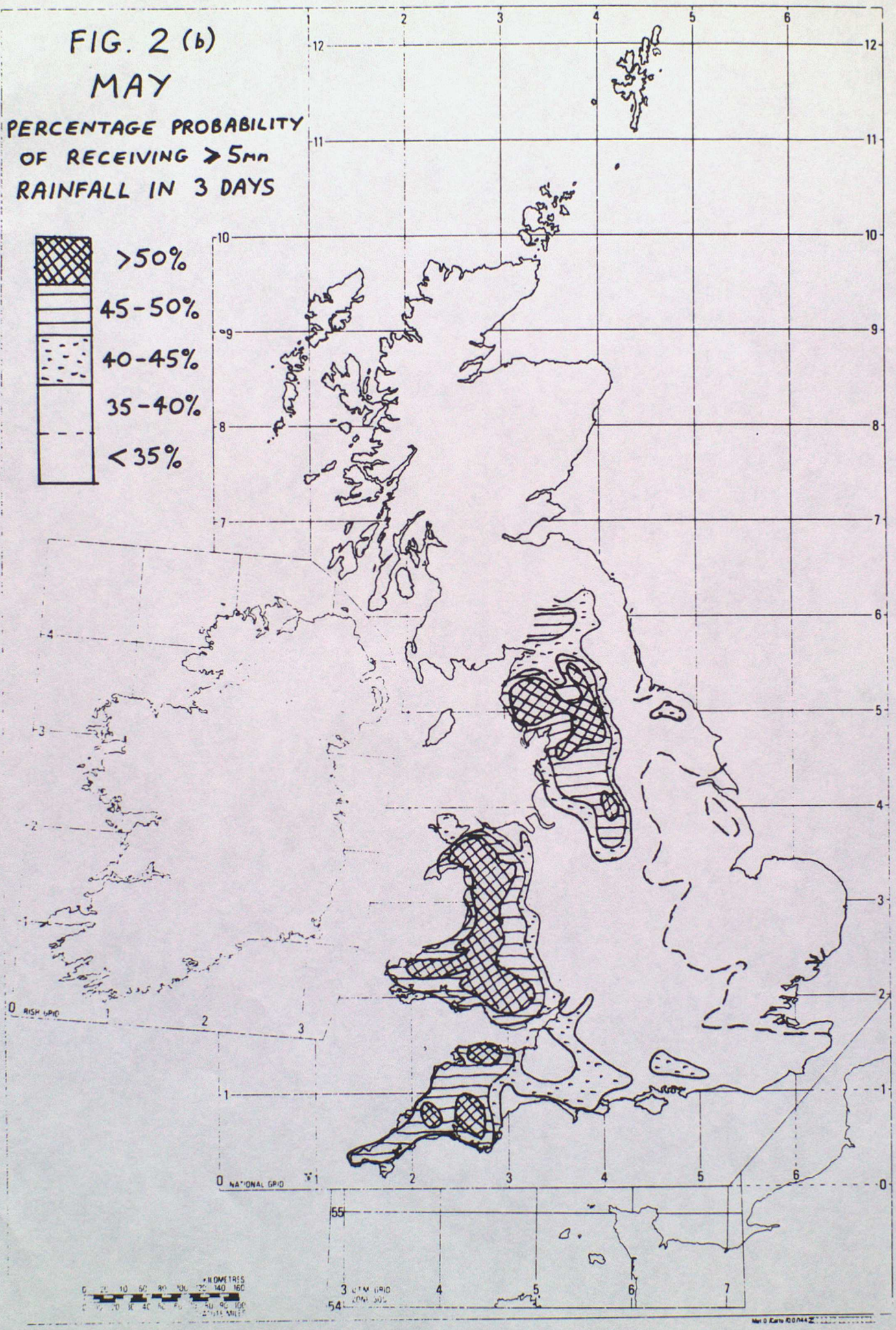

FIG. 2 (c)

JUNE

PERCENTAGE PROBABILITY OF RECEIVING ≥ 5mm RAINFALL IN 3 DAYS